U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

10.4.4 TURBINE BYPASS SYSTEM

REVIEW RESPONSIBILITIES

Primary - Power Systems Branch (PSB)

Secondary - None

I. AREAS OF REVIEW

The turbine bypass system (TBS) provides operational flexibility so that the plant may accept certain load changes without disturbing the nuclear steam supply system. The TBS is designed to discharge a stated percentage of rated main steam flow directly to the main condensers, bypassing the turbine. This steam bypass enables the plant to take step load reductions up to the TBS capacity without the reactor or turbine tripping. The system is also used during startup and shutdown to control reactor pressure for a boiling water reactor (BWR) and steam generator pressure for a pressurized water reactor (PWR). The TBS is not required for safe shutdown as the relief and safety valves are operated under emergency conditions. The system is not required to function as a heat sink for the prevention or mitigation of postulated accidents. Failure of the TBS during a load reduction or turbine trip would result in the actuation of the relief valves and possibly the safety valves.

The PSB reviews the system from the branch connection at the main steam system to the main condensers.

1. The PSB reviews the TBS to determine that a failure of the system or system components will not have an adverse effect on essential equipment.

2. The PSB reviews the TBS functional requirements for both normal and abnormal operating conditions, and with respect to the following: (a) capability to isolate those portions of the system that could leak or malfunction; (b) capability to perform adequate operational testing and inservice inspection; (c) to assure there are no adverse effects of postulated system piping failures on safety-related equipment; and (d) to reduce the possibility of reactor transients due to inadvertent operation of the TBS from faults in the TBS instrumentation and control.

In the review of the turbine bypass system the PSB will coordinate other branches' evaluations that interface with the overall review of the system as follows: The Mechanical Engineering Branch (MEB) determines that the appropriate seismic and quality group classifications have been established for system components as part of its primary review responsibility for SRP Sections 3.2.1 and 3.2.2. The Auxiliary Systems Branch (ASB) determines that TBS is in accordance with Branch Technical Positions ASB 3-1 and MEB 3-1 as related to cracks and breaks in high- and moderate-energy piping outside of containment as part of its primary review responsibility for SRP Section 3.6.1. The Reactor Systems Branch (RSB) determines that the steam bypass capacity is consistent with reactor transient analysis as part of its primary review responsibility for SRP Section 4.4. The Procedures and Test Review Branch determines the acceptability of the preoperational and startup tests as part of its primary review responsibility for SRP Section 14.0.

The reviews for fire protection, technical specifications, and quality assurance are coordinated and performed by the Chemical Engineering Branch, Licensing Guidance Branch, and Quality Assurance Branch as part of their primary review responsibility for SRP Sections 9.5.1, 16.0, and 17.0, respectively.

For those areas of review identified above as being part of the primary review responsibility of other branches, the acceptance criteria necessary for the review and their methods of application are contained in the referenced SRP sections of the corresponding primary branches.

II. ACCEPTANCE CRITERIA

Acceptability of the design of the turbine bypass system, as described in the applicant's safety analysis report (SAR), is based on the specific General Design Criteria, industry standards, and other criteria listed below and on the similarity of the design to that of plants previously reviewed and found acceptable.

The design of the turbine bypass system is acceptable if the integrated design of the system is in accordance with the following criteria:

1. General Design Criterion 4 in that failure of the TBS due to a pipe break or malfunction of the TBS should not adversely affect essential systems or components (i.e., those necessary for safe shutdown or accident prevention or mitigation).

2. General Design Criterion 34 as related to the ability to use the system for shutting down the plant during normal operations. The operation of the TBS eliminates the need to rely solely on safety systems which are required to meet the redundancy and power source requirements of this criterion.

III. REVIEW PROCEDURES

The procedures below are used during the construction permit (CP) review to determine that the design criteria and bases and the preliminary design as set forth in the preliminary safety analysis report meet the acceptance criteria given in subsection II of this SRP section. For review of operating license (OL) applications, the procedures are used to verify that the initial design criteria and bases have been appropriately implemented in the final design as set forth in the final safety analysis report.

The procedures for OL applications include a determination that the content and intent of the technical specifications prepared by the applicant are in agreement with the requirements for system testing, minimum performance, and surveillance, developed as a result of the LGB review, as indicated in subsection I of this SRP section.

The primary reviewer, will coordinate this review with the other branches' areas of review as stated in subsection I of this SRP section. The primary reviewer obtains and uses such input as required to assure that this review procedure is complete.

The reviewer selects and emphasizes material from this SRP section as may be appropriate for a particular case.

1. The SAR is reviewed to determine that the system description and piping and instrumentation diagrams (P&IDs) delineate the system and components.

2. The SAR is reviewed to verify that the system design bases and an evaluation of the system capacity are provided, including the relation between the TBS capacity and relief valve capacity in terms of percentage of rated main steam flow, the maximum reactor power step change the system is designed to accommodate without a reactor or turbine trip, and the maximum electric load step change the reactor is designed to accommodate without reactor control rod motion or steam bypassing.

3. The reviewer uses engineering judgment and the results of failure modes and effects analyses to determine that:

   a. Failure of the TBS to operate will not preclude operation of any essential systems. Statements in the SAR that confirm the above are acceptable.

   b. Failure of the TBS high energy piping will not have adverse effects on any safety-related systems or components that may be located close to the system.

IV. EVALUATION FINDINGS

The reviewer determines that sufficient information has been provided and that the review supports conclusions of the following type, to be included in the staff's safety evaluation report:

> The turbine bypass system (TBS) includes all components and piping from the branch connection at the main steam system to the main condensers. The scope of review of the turbine bypass system for the _____ plant included layout drawings, piping and instrumentation diagrams, and descriptive information for the TBS and auxiliary supporting systems that are essential to its operation.
>
> The basis for acceptance of the TBS in our review was conformance of the designs, design criteria, and design bases to the Commission's regulations as set forth in General Design Criteria (GDC) 4 and 34 of Appendix A to 10 CFR Part 50.

1. The applicant has met the requirments of GDC 4 "Environmental and Missile Design Bases" with respect to the system being designed such that a safe shutdown will not be precluded as a result of the TBS failure.

2. The applicant has met the requirements of GDC 34 "Residual Heat Removal" with respect to the ability to use the turbine bypass system for shutting down the plant during normal operations. The turbine bypass system is designed such that sufficient steam can be bypassed to the main condenser so that the plant can be shutdown during normal operations without using the turbine generator.

The staff concludes that the design of the turbine bypass system conforms to all applicable GDC's, staff positions and industry standards and is therefore acceptable.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 4, "Environmental and Missile Design Bases."

2. 10 CFR Part 50, Appendix A, General Design Criterion 34, "Residual Heat Removal."

3. Regulatory Guide 1.68, "Initial Test Programs for Water Cooled Reactor Power Plants."

4. Branch Technical Positions ASB 3-1, "Protection Against Postulated Piping Failures in Fluid Systems Outside Containment," attached to SRP Section 3.6.1.

5. Branch Technical Position MEB 3-1, "Postulated Break and Leakage Locations in Fluid System Piping Outside Containment," attached to SRP Section 3.6.2.